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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/678,438	10/03/2003	Vladimir V. Makarov	65.0395	1593

20686 7590 07/05/2005

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EXAMINER

AHMED, SHAMIM

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 07/05/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/678,438

Applicant(s)

MAKAROV ET AL.

Examiner

Shamim Ahmed

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 October 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-58 is/are pending in the application.
- 4a) Of the above claim(s) 37 and 52-58 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-30, 34-36, 38 and 40-51 is/are rejected.
- 7) ☒ Claim(s) 31-33 and 39 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 03 October 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-36 and 38-51, drawn to a process, classified in class 216, subclass 63.
 - II. Claims 37 and 52, drawn to a product by process, classified in class 257, subclass 758.
 - III. Claims 53-58, drawn to an apparatus, classified in class 156, subclass 345.4.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the process can be used to make another and materially different product such as an article having aluminum adjacent to dielectric such as silicon dioxide.
3. Inventions I and III are related as process and apparatus for its practice. The inventions are distinct if it can be shown that either: (1) the process as claimed can be practiced by another materially different apparatus or by hand, or (2) the apparatus as claimed can be used to practice another and materially different process. (MPEP §

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806.05(e)). In this case the apparatus can be used to practice another and materially different process such as milling aluminum or other metals instead of copper.

4. Inventions II and III are related as apparatus and product made. The inventions in this relationship are distinct if either or both of the following can be shown: (1) that the apparatus as claimed is not an obvious apparatus for making the product and the apparatus can be used for making a different product or (2) that the product as claimed can be made by another and materially different apparatus (MPEP § 806.05(g)). In this case the product can be made by different apparatus such as a chemical etching apparatus.

5. Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

6. During a telephone conversation with Greg Durbin on 6/9/05 a provisional election was made with traverse to prosecute the invention of Group I, claims 1-36 38-51. Affirmation of this election must be made by applicant in replying to this Office action. Claims 37 and 52-58 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

7. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Remarks

8. It is noted that during the telephone conference with Greg Durbin on 6/9/05, examiner discussed only claim 52 is an article or product claim but upon further review, claim 37 is also an article claim and obviously included with the non-elected invention (Group II).

Claim Objections

9. Claim 1 is objected to because of the following informalities: In line 6, the use of the word "than" is twice. Appropriate correction is required.

Claim Rejections - 35 USC § 112

10. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

11. Claims 1-36 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

12. Regarding claim 1, step b) line 4, the phrase "contains atoms of at least one of carbon and silicon-----to stop the oxidation of the dielectric" renders the claim indefinite because it is unclear whether the limitation is directed to the copper or the oxidizing agent.

13. Regarding claim 4, the phrase "wherein the oxidizing agent is oxygen" renders the claim indefinite because it is unclear how oxygen contains atoms of at least one of carbon and silicon?

14. Similar analysis applies to claim 5 because the oxidizing agent is nitrogen.

Claim Rejections - 35 USC § 103

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

16. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

17. Claims 1-4, 6-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Crawford (6,653,240) in view of Phaneuf et al (6,641,705).

Crawford discloses a process for circuit fabrication, wherein conductor (4) such as copper adjacent to organic dielectric layer (2) and the copper is milling with FIB with a gas assisted etch using xenon difluoride as oxidizing agent (col.2, lines 50-63 and col.3, lines 41-46).

Crawford fails to teach the precursor contains oxidizing agent having a sticking coefficient greater than about 0.01 and a residence time longer than about 100 ns on the copper.

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However, Phaneuf et al teach a process for FIB ion milling of copper with the presence of oxygen and/or other oxidizing agents for selectively inhibits the etching of the dielectric material (col.4, lines 25-39 and lines 60-65 and col.14, lines 11-25).

Phaneuf et al also disclose a typical focused ion beam system including typical pressure and the strength of the ion beam (col.6, lines 25-65).

Phaneuf et al do not explicitly disclose that the oxidizing agent having the claimed sticking coefficient but it would have been obvious to have the same because the oxidizing agent and the purpose of the use is exactly same as the instant invention and expected to have the same result.

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to replace Crawford's gas with Phaneuf et al's teaching for uniform milling of copper by selectively inhibits the etching of the adjacent dielectric material as taught by Phaneuf et al.

As to claims 10-13, it would have been obvious to one of ordinary skilled in the art to optimize the process conditions because it has been held that the general process of FIB is known in the art and discovering an optimum value of a result effective variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

18. Claim 5 is rejected under 35 U.S.C. 103(a) as being unpatentable over Crawford (6,653,240) in view of Kuckertz et al (6,613,394).

Crawford discusses above in the paragraph 17 but fail to teach the precursor contain an oxidizing agent of nitrogen.

However, Kuckertz et al teaches processing gas of nitrogen, oxygen or xenon difluoride can be used as an oxidizing agent (col.6, lines 46-61).

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to replace Crawford's xenon difluoride with nitrogen because both of them are functionally equivalent as effective oxidizing agent as taught by Kuckertz et al.

19. Claims 1-2,30,34-36,38,40-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Crawford (6,653,240) in view of Fischer et al (US 2004/0132287).

Crawford discusses above in the paragraph 17 but fail to teach the precursor contain a compound based on siloxane.

However, Fischer et al teach a process of focused ion beam milling of copper wherein a compound such as tetra methyl cyclo tetra siloxane (TMCTS) assists in the milling of copper (paragraphs 0008,0026-0027).

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to combine Fischer et al's teaching into Crawford's process for efficiently milling copper by assisting the milling process as taught by Fischer et al.

As to claims 41-42,49-50, it would have been obvious to one of ordinary skilled in the art to optimize the process conditions because it has been held that the general process of FIB is known in the art and discovering an optimum value of a result effective

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variable involves only routine skill in the art. *In re Boesch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980).

Allowable Subject Matter

20. Claims 31-33 and 39 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

21. The following is a statement of reasons for the indication of allowable subject matter: The prior art does not teach a copper milling process using FIB with the introduction of a compound based on silazane such as hexa-methyl cyclo tri-silazane.

Conclusion

22. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Shuman et al (6,322,672) teach a process for enhancing FIB milling of copper by applying a gas such as oxygen or other oxygen containing gas by inhibiting the etching of dielectric material (col.5, lines 17-24).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shamim Ahmed whose telephone number is (571) 272-1457. The examiner can normally be reached on M-Thu (7:00-5:30) Every Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Shamim Ahmed
Primary Examiner
Art Unit 1765

SA
June 28, 2005